PART ONE: REMARKS

Rejection under 35 U.S.C. § 102(b)

Claims 1, claims 5/1 and 6/1, and presumably all claims dependent on claim 1, have been rejected under 35 U.S.C. § 102(b) as being anticipated by Kuc.

As to claims 1, 5/1 and 6/1, the Examiner asserts in paragraph 3 of the Office Action that:

> "The Kuc reference discloses the utilization of a biometric sonar system (see FIG. 1), comprising a transmitter and two receivers (see FIG. 1) that use acoustic signal waveforms (see page 727, right column, 6th line from the bottom) and processing (see page 728, left column, line 26-28) similar to those used by dolphins for echolocation in which acoustic pulses are radiated by the transmitter, two or more channels of pulse echoes are received by the received and processed to generate acoustic images and probable identification of objects (see abstract) in the ensonified field as recited in [Applicants' claims 1, 5/1 and 6/1]."

The anticipation rejection cannot stand because Kuc does not teach every element of Applicants' invention, and in particular, the waveforms disclosed by Applicants

Using a binaural system and processing echoes is not Applicants' invention; rather, Applicants disclose a system and method of generating "**acoustic signal waveforms** ... similar to those used by dolphins" (claim 1, emphasis added) and of receiving and processing water-borne echoes of those waveforms.

Kuc uses a single transmitter and two receivers, like a preferred embodiment Applicants' invention, and both systems transmit an acoustic waveform and receive and process echoes of those transmissions. The resemblance ends there. The confusion between Kuc's apparatus and Applicants' invention results largely from Kuc's loose use of the term "dolphin-like". As explained below, "dolphin-like" means something substantially, spectrally, and temporally different in Kuc than in the Application.

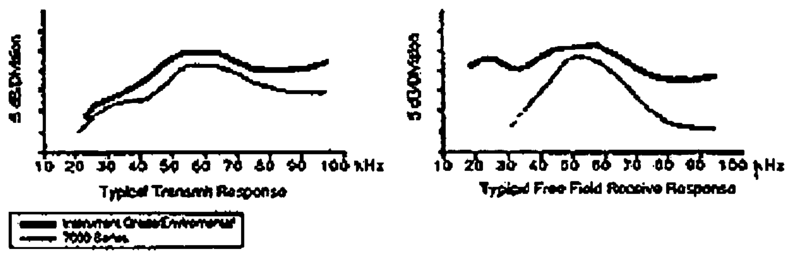
First, Kuc's system works only in air; Applicants' invention works in water, as well as in air. The acoustic properties of air and water are very different, and water is the more technically challenging environment; the speed of sound in water is about five times that in air, and the spacing,

type, environmental interface, and impedance matching of the transducers is much more problematic. Kuc's system would not work underwater because of the transducers he used. Moreover, his enablement is limited to an ensonified object that is symmetrical and isolated. Kuc does not disclose or suggest an underwater embodiment. Being limited to airborne echolocation, Kuc's system is not "dolphin-like".

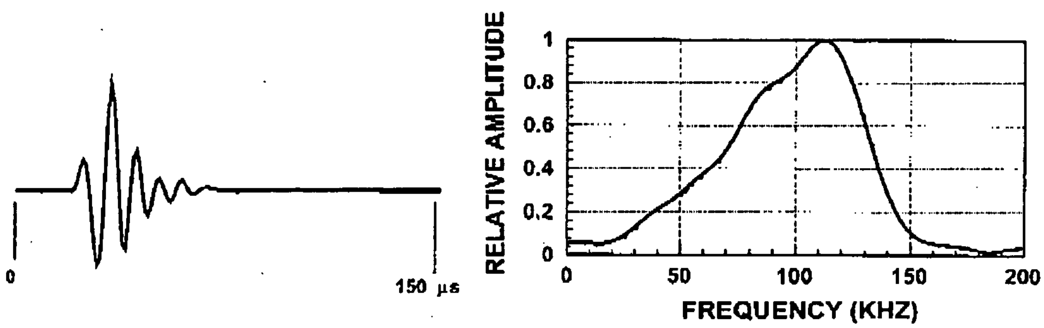
Second, dolphins do not transmit from their mouths, but rather from their foreheads ("melons"), and appear to hear echo returns through their lower jaws, which contain sound-conducting fat channels. In Applicants' invention, the transmitter is located above the receivers; in Kuc's system, the transmitter is located either in the same plane as the receivers or below them. Kuc's system is therefore not "dolphin-like" in the configuration of the transmitter and receivers.

Every sonar system uses acoustic signals and those acoustic signals must have some kind of transmitted signal waveform, receiver spectral sensitivity, and return processing. Kuc loosely alludes to a resemblance of his system to the echolocation used by bats and dolphins; in fact, his signal waveform bears no practical resemblance to either. The Polaroid transmitter used by Kuc is driven by a square-wave pulse, and the waveform properties of Kuc's transmitter are entirely fixed by the structure of the transducer and its resulting resonant frequency. Kuc's transducers, both as transmitter and receivers, have a resonant frequency between 50 kHz and 60 kHz (see below). Unlike Applicants, Kuc does not shape the waveform in the transmission chain, either electrically (pre-transducer) or acoustically (post-transducer); Kuc uses the Polaroid "rangefinder waveform", without modification, that is close to a white noise spectrum. Depending on the dolphin, the spectrum of dolphin echolocation clicks can peak between 110 kHz and 120 kHz, with amplitude at 50 kHz approximately 25% of the peak amplitude. Peak amplitudes of dolphin echolocation clicks are rarely below 80 kHz, and the waveform spectrum is always more of a steep-skirted Gaussian curve than white noise. The signal input and output waveforms of the Polaroid transmitter are therefore very different from the signal input and output waveform observed in dolphins. Again, Kuc's system is not "dolphin-like".

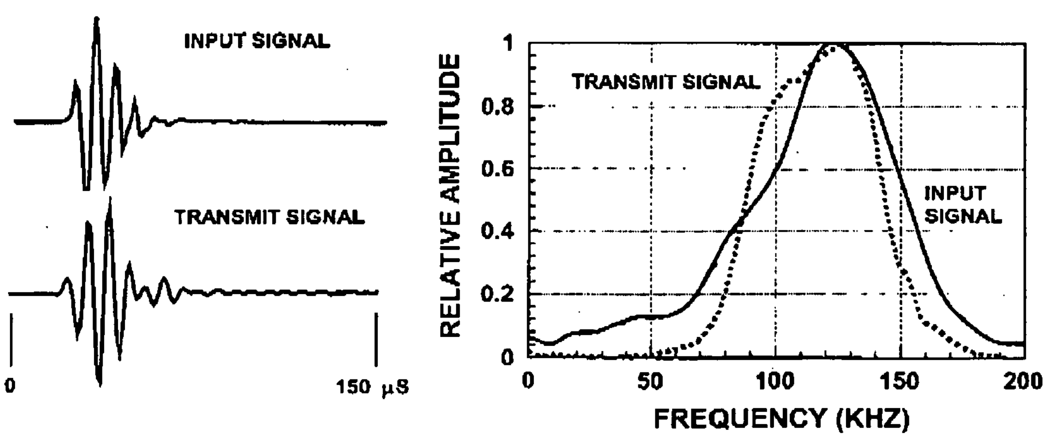
The transmit signal of the transducer used by Kuc is shown in the following figure taken from the current Polaroid datasheet (www.polaroid-oem.com/pdf/electrans.pdf). Compare the Polaroid transducer spectra with those shown for dolphins and for Applicants' invention (Kuc discloses a 12 degree beam on page 728, right column, line 7, which is likely the upper ("Instrument/ Environmental") trace in the graphs below; the Polaroid 7000 series has a 17 degree beam).



Polaroid transducer response curves, in air



Transmitted waveform and spectrum of dolphin echolocation clicks, in water



Waveforms and spectrum of Applicants' invention, in water

By design, Applicants's invention shapes the waveform in the transmission chain to generate a transmitted waveform in water that is almost identical to those of dolphins studied by Applicants. Applicant's acoustic waveform is very dolphin-like, and Kuc's is not.

Although Kuc describes a binaural system, Kuc's disclosure is enabling only for a monaural system and for recognition of solitary, isolated objects that have dimensions "comparable in size to the wavelength" (page 727, right column, first full paragraph, lines 3-4) of the transmitted signal. "This paper considered only symmetric objects that produce identical echoes from any view direction. In this case only the echoes from one receiver need to be stored, since the other [receiver] detects an identical object." (Page 728, right column, section 7, second paragraph, lines 1-4) "This paper considered the simple case of isolated objects." (Page 728, right column, section 7, third paragraph, lines 1-2) Applicants' invention, in contrast, is truly binaural, and recognizes multiple objects of greatly varying dimensions, underwater, in the presence of interfering echoes.

Kuc takes a summary of the amplitude of echoes over time (Page 729, section entitled "Echo Processing", and Figure 8. page 732) to trace the change in echo amplitude, and unlike Applicants' invention, does not use the spectral content of the echo waveform. The "features" that Kuc extracts from received echoes (Page 731, section entitled "Learning phase") are the "amplitude envelopes" of echoes from the front face of symmetrical, isolated, ensonfied objects, as opposed to real-world object recognition. The impedance of objects is much closer to the impedance of water than to the impedance of air. Echoes of objects in water may return from the front face of the object, from the back face, and from waves that creep around the surface of the object. Multiple internal reflections are also possible. In air, echoes are pretty much limited to the front face of the object, as shown in Kuc's Figure 6 (Page 731). Because of the impedance mismatch between solid or liquid-filled objects and air, airborne clicks do not penetrate the objects. In water, however, echoes are not limited to the front face of objects, and water-borne clicks penetrate objects since there is far closer matching of impedances (thus, Kuc's remark, "Identifying an object in the presence of interfering echoes ... is a difficult problem that makes one marvel at how dolphins are able to detect shellfish buried under a few inches of sand." Page 728, right column, section 7, third paragraph, lines 8-9, 12-14). This difference between water and air environments has profound effects on the waveform and spectra of returning echoes in the two media, and how echo waveforms are processed. Kuc has recognized a fundamental difference between his bench-top experiment and underwater systems, but has not identified the problem (impedance matching and implications for interrogation and echo waveforms) or the solution, as Applicants have.

Finally, Kuc moves his system on a robot arm and rotates the ears to maximize received amplitude, but does not process the spectral content of the received waveform itself, as dolphins are believed to do and as Applicants' invention does. Kuc's procedure seems to require finding an

elevation that provides a unique echo signature for the object (section entitled "Learning phase", page 731). Applicants' invention does not. Moreover, dolphins lack external pinnae to rotate, as bats do. It would be far more accurate to state that Kuc's system is bat-like, not dolphin-like.

The rejection cannot stand because Kuc fails to meet the burden imposed by MPEP 2131 and by case law for rejections under 35 USC 102(b)

"The **identical invention** must be shown in as complete detail as is contained in the ... claim." Richardson v. Suzuki Motor Co., 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). (emphasis added) "To anticipate a claim, the reference must teach every element of the claim." MPEP 2131 (original text capitalized) Applicants disclose "acoustic signal waveforms and processing similar to those used by dolphins" (claim 1) in water, and how to make and use those waveforms and binaural processing, and Kuc does not. Specifically, Kuc's acoustic signal waveforms are unlike those used by dolphins, and are limited to airborne environments. Not only are the waveforms different, Kuc's system includes and relies on different structural elements, such as a robot arm and rotating ears, that Applicant's invention lacks. Therefore, Kuc does not anticipate Applicants' invention under 35 USC 102(b). The "acoustic signal waveforms" transmitted and processed by Applicants' invention, and the difference in structural elements, distinguish Applicant's invention over Kuc.

REMARKS (OF PART TWO)

Only if the Remarks in Part One of the Response are unpersuasive, Applicants request that the amendment of claims set forth in Part Two of this Response be entered in the record. In response to the rejection of claim 1, and of claims dependent on claim 1, in the Second Office Action and the failure of the Remarks in Part One to traverse that rejection, in Part Two of this Response, claim 1 has been cancelled, claims 4 to 20 have been amended to depend only from claims 2 and 3, and copies of each of claims 4 to 20 have been combined with a copy of claim 1 (as previously amended) to create new independent claims 27 to 42. New, independent claims 27 to 42 add the limitations of each dependent claim, respectively, to claim 1 and thereby distinguish the new claims over the Kuc reference cited by the Examiner in the Second Office Action as anticipating claim 1.

CONCLUSION

In Part One, Applicants have shown that Kuc is bat-mimetic, not dolphin-mimetic: Kuc uses different structural elements and a very un-dolphin-like "Polaroid rangefinder" waveform, and therefore is not the same invention. Applicants have provided a two-part Response to the Second Office Action. If the Remarks of Part One traverse the rejection of claim 1 and claims dependent on claim 1, Applicants respectfully solicit an early notice that all pending claims are allowable.

If the Remarks of Part One fail to traverse the rejection based on anticipation of claim 1 by Kuc, Part Two of the Response provides amended claims, Remarks, and a request to enter the amended claims in the record and thereby place the application in condition for allowance.

The Examiner is invited to contact Applicants' undersigned representative if there are any questions relating to the subject application.

Respectfully submitted,

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